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Volume I - Summary Document

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This Alternatives Report is an interim document in the Mountain Communities Wastewater Management Assessment. The Report identifies and discusses available engineering techniques, management systems, and financial alternatives appropriate for use in mountain communities. Following identification and description of available technical, management and financial alternatives, methodologies are presented for selecting the most appropriate alternatives for a given situation. The Report is presented in four volumes: Volume I - Summary Document; Volume II - Technical Engineering Alternatives; Volume III - Institutional Management Alternatives; and, Volume IV - Financial Alternatives.

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REGION IV - ATLANTA

MOUNTAIN COMMUNITIES WASTEWATER MANAGEMENT ASSESSMENT

ALTERNATIVES REPORT
VOLUME I

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VOLUME I

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VOLUME I

INTRODUCTION

This is the first of four volumes which make up the Final Alternatives Development Report for the Mountain Communities Wastewater Management Assessment. This first volume contains Chapter 1--Introduction and Chapter 2--Executive Summary, Findings and Conclusions.

Chapter One is an introduction to the Alternatives Development Report as a whole. This chapter also gives a brief project background description. The executive summary--Chapter Two--briefly and concisely summarizes the key findings of this report. This includes the identification of most appropriate alternatives for specific conditions and needs and factors which were found to limit implementation.

VOLUME I

CHAPTER 1

INTRODUCTION

1.1 Introduction and Background

The goal of the Mountain Communities Wastewater Management Assessment is to review and document the unique problems of the study region and develop recommendations and guidance to help implement feasible solutions. The project study area includes 82 largely rural counties in six states which have been identified by the Appalachian Regional Commission as the highlands portion of southeastern Appalachia. This area is shown on Figure 1-1 which follows.

This Draft Alternatives Development Report is the third document prepared as part of the Mountain Communities Assessment. The first report, Mountain Communities Assessment, Final Background and Orientation Report, November 1983, defined the project's objectives, generally discussed the problems and issues which needed to be addressed and set forth a plan of study for the project.

The second report prepared for this project, the Survey of Existing Conditions Report, February 1984, set the stage for this Alternatives Development Report by describing in detail natural and man-made characteristics of the study area and discussing their actual and potential impact on wastewater management in the study area. This review identified a number of features which were found to limit the success of wastewater management efforts within the study area. Among those issues which were identified, the following were considered to be the most significant:

- average income is well below both state and national averages with significant numbers of residents below the poverty line,
- population has been rising at a greater rate than at the state or national level since 1970 and is projected to continue to increase,

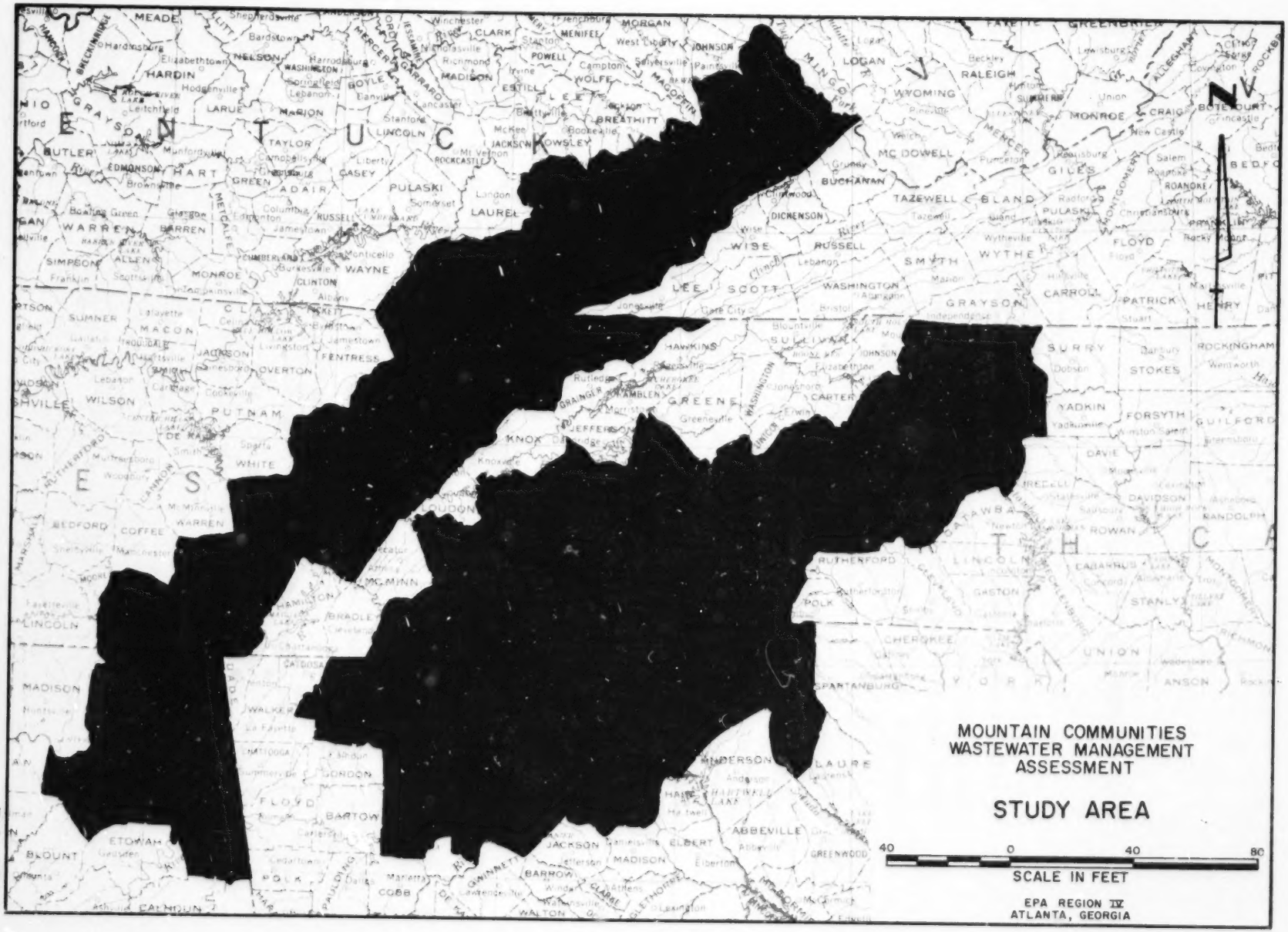
MOUNTAIN COMMUNITIES
WASTEWATER MANAGEMENT
ASSESSMENT
STUDY AREA
40 0 40 80
SCALE IN FEET
EPA REGION IV
ATLANTA, GEORGIA
N
KENTUCKY
TENNESSEE
VIRGINIA
NORTH CAROLINA
SOUTH CAROLINA

FIGURE 1-1

- population is highly dispersed due to mountainous terrain and lack of land use controls,
- 60% of study area homes are on individual water supply systems,
- most study area residents rely on on-site wastewater disposal with many using straight pipes or privies,
- although use of on-site systems is feasible in many parts of the study area, failures still occur, due primarily to poor installation, design and O&M practices,
- septic tanks which do fail are causing well contamination on small lots,
- water quality problems are occuring from non-functioning centralized treatment plants,
- very few 201 plans have been implemented,
- most facility planning has been done for larger communities.

The objective of this document is to identify and discuss available engineering techniques, management systems and financial alternatives appropriate for use in small mountain communities based on limiting characteristics and other implementation problems identified in the Survey of Existing Conditions Report and listed above. Following identification and description of available technical, management and financial alternatives, methodologies are presented for selecting the most appropriate alternatives for a given situation.

1.2 Glossary

The following is a glossary of pertinent terms used throughout this report.

- Fact Sheet--a summary in fold-out table form of key information on alternatives presented in each chapter.
- Technique--method or procedure used for carrying out or performing wastewater activities, e.g.--

  engineering techniques--septic tank; holding tank; surface sprinkler.

  management techniques--sanitarian survey; land management; permit program.

  financing techniques--EPA Construction Grant; North Carolina Clean Water Bond; tapping fee.
- Management Function--activities, such as planning, design and permitting, which are necessary to maintain adequate public service and to guarantee long-term performance of a wastewater system. Management techniques are used to carry out these functions.
- Management System--Overall process for organizing and carrying out all functions necessary to adequately meet community wastewater needs, e.g. the Conventional Homeowner-Centered Management System.

CHAPTER 2

EXECUTIVE SUMMARY

2.1 Summary of Technical Engineering Alternatives

A wide variety of engineering techniques are available for managing wastewater and sludge generated by mountain communities. Wastewater techniques appropriate for individual homes and business establishments usually include a septic tank in conjunction with one of an array of soil absorption systems for final treatment and disposal. Basically, soil absorption techniques consist of beds, trenches and mounds, all of which can be constructed in various configurations to meet specific site conditions. Trenches are preferred where soils are deep and well-drained. Mounds extend the use of soil absorption to areas with shallow soils. These systems may be further modified including use of aerated septic tanks and low pressure distribution of effluent to meet siting limitations related to land slope, hydraulic conductivity and depth of unsaturated soil.

Additional options where no ground absorption is possible include privies, holding tanks and small scale discharging alternatives such as a sand filtration system.

Cluster systems would be those employed to treat and dispose of wastewater from a group of congregated individual homes or businesses. Cluster systems can be more feasible than separate systems for each establishment if the individual homes or businesses are too densely concentrated, if variable soil conditions make one large absorption area more feasible, or if a discharging system is the only option. Typically, a cluster system would use one of the land disposal techniques discussed above; however, slow rate irrigation or systems employing surface water discharge are also feasible.

Where cluster systems are used it becomes necessary to use some form of wastewater collection system. Among the feasible collection systems which

are discussed in Chapter 3 are small diameter gravity sewers which require use of individual septic tanks; pressure sewers which also require either a septic tank or grinder pumps; or vacuum sewers.

Small community systems are used in this report to refer to facilities that handle flows from more than a cluster of establishments or flows up to 100,000 gallons per day. Small community systems may be appropriate where individual or cluster-type systems are not adequate because of large sewage volumes or service area size.

Engineering techniques for small communities include many of the approaches applicable for cluster systems. Collection systems would include those identified above plus conventional gravity sewers. Soil absorption is generally too costly for all but the smallest community. For larger systems, various types of biological treatment including rotating biological contactors, different lagoon systems, conventional extended aeration, trickling filters, slow rate spray irrigation, overland flow and marsh/pond/meadow systems merit consideration.

Centralized systems are defined as those that handle more than 100,000 gallons per day. Centralized systems have historically been used for most communities with large population concentrations. These systems have high construction, operation and maintenance costs and their use is being increasingly questioned and evaluated against alternative techniques for all but the largest, most densely settled areas.

Wastewater collection treatment and disposal techniques typically used for centralized systems are discussed in Chapter 3. Small diameter and pressure sewers may be used, but large diameter gravity sewers, force mains and pumping stations are typically favored. Treatment works are generally quite complex, often designed to produce high quality effluent. Some plants even incorporate advanced filtration to remove additional nitrogen, phosphorus, metals or organic compounds. Disposal techniques most often include stream discharge, with some facilities using land application.

Most of the engineering techniques identified above are technologically simple: problems that do arise are typically the result of improper installation or operation, maintenance and repair. Any one of a number of problems following system design could completely eliminate a system's effectiveness. Most of these problems can be minimized, however, by use of a qualified site inspector, good communication between the inspector and contractor and other installation procedures as discussed in Section 3.3.

In general, systems with the most hardware and moving parts are those which require the most operation, maintenance and repair, but even conventional septic systems require periodic maintenance. The most common maintenance procedure for on-site systems is pumping out of accumulated solids. The recommended minimum frequency varies depending on tank size and usage. If pumping is not performed as needed, solids will accumulate in drain fields greatly limiting their effectiveness. OMR procedures for collection and treatment systems can become quite complex. Sewers should be flushed and periodically inspected. Treatment plants should be inspected at least weekly.

Other measures can also be taken to ensure proper, efficient functioning of any of these techniques. Practices within the home or business that can enhance performance of any wastewater system include:

- use of water saving devices,
- avoiding or discontinuing use of garbage disposals,
- using grease traps,
- separating toilet wastes (blackwater) from other wastewaters (greywater),
- diverting roof runoff away from wastewater system,
- increasing hydraulic gradient by lowering the groundwater table,
- diverting storm runoff from absorption areas.

Specific design practices can also be utilized to more effectively design small systems. These include detailed procedures for soil and site evaluations, proven methods for adapting systems to particular site conditions, sizing systems and methods for distributing effluent.

A recommended approach for selecting the appropriate engineering technique would be to consider the alternatives in order of increasing complexity. In other words, develop a characterization of community wastewater needs and then determine whether they can be met using conventional on-site systems, alternative on-site systems, cluster or small community conventional or innovative techniques or centralized systems. The least complex systems are typically least expensive, most straightforward to install, and require the least amount of OMR. However, the simplest techniques will not be appropriate for all communities. In some locations more complex systems may be needed to ensure adequate performance. In selecting which technique to implement, four basic factors should be evaluated: costs, environmental impacts, operation and implementation. Any one of these can rule out use of a certain technique.

2.2 Summary of Institutional Management Alternatives

Proper management of community wastewater systems requires that the following seven management functions be performed:

- problem identification,
- system planning and design,
- construction and installation,
- permitting,
- operation and maintenance,
- monitoring and compliance,
- training and public education.

There are many different ways in which these functions may be carried out and at least five general system types available which can be used to coordinate all management functions.

For example, the problem identification function can be performed using sanitarian surveys, water quality sampling, aerial photography, water meter installation or a combination of these techniques. The same range of optional techniques is available to carry out most of the required management functions.

The selection of a most appropriate technique is dependent upon a number of factors including degree of wastewater problems, available expertise, funds available and, particularly, the type of management system which will be used to carry out the functions. Under different general system types, the responsibility center for each function may change, in turn altering the type of technique which may be most suitable for performing the function.

The five general management system models which have been proposed include:

- conventional homeowner-centered,

- conventional system with monitoring,
- private ownership with required operation, maintenance and monitoring,
- private ownership with public operation and maintenance,
- public sector-oriented management.

Selection of the management system which is most appropriate for a particular community should be made after thorough evaluation of such limiting factors as:

- natural physical limitations,
- existing wastewater needs and problems,
- growth and development patterns,
- available expertise,
- community attitudes,
- available regulatory authority.

The conventional homeowner-centered management approach is most appropriate for highly rural communities with low population densities, a predominance of on-site systems, low growth rates, large areas of suitable soils, and few existing problem areas. Though limited regulatory authority and technical expertise are necessary, the basic approach can be improved significantly if the management agency staff has the capabilities to assist homeowners and installers in design and installation of alternative systems where lot sizes or natural features limit conventional septic tank-soil absorption systems. This management approach is further improved if at least a limited public education program is carried out, particularly to address the benefits of, and best techniques for, water conservation. Public education is a very important component of a wastewater management program.

The addition of monitoring to the conventional homeowner-centered approach results in a system which may be more suitable for communities with a higher number of failing on-site systems, less suitable natural conditions, or privately-owned cluster systems. Monitoring of system

performance either directly by the management agency or supervised by the agency can help ensure that systems are properly operated and maintained and that they continue to function properly. The addition of the responsibility for monitoring, however, adds to the level of expertise required and if performed directly by the public agency will require greater legal authority.

The third model system incorporates required operation and maintenance along with monitoring. Under this system O&M would not be performed by the management agency, but would be required and supervised by the agency. Techniques which can be used to oversee required O&M would include:

- revocable operating license,
- deed attachment,
- septage collection and disposal program,
- maintenance permit forms,
- service call light system.

This alternative is still most applicable for communities where on-site systems are most prevalent. However, because proper O&M will be ensured, this approach is also more suitable for alternative and innovative on-site and cluster systems as well as small, private package plants or alternative small community systems.

Staff expertise and regulatory authorities required for this management system need not be any greater than for the second alternative as long as operation and maintenance activities are carried out by a private contractor.

The fourth alternative system model differs significantly from previous approaches by shifting responsibility for operation and management, as well as monitoring, to a public management agency. This approach would be suitable for communities with major wastewater management needs and it would apply to any system type. It is the surest approach for ensuring proper functioning of facilities, however, application of this system may

be limited by the level of expertise and regulatory authority required. The number of personnel and level of expertise required may be beyond the range of many mountain communities.

The final alternative managment system model concentrates all management activities and ownership of wastewater facilities in the public sector. This approach is typical in more densely settled suburban and urban areas where conventional collection and treatment systems are most prevalent. Public ownership may also be applied to on-site cluster and small community systems and such complete public responsibility may be most appropriate for communities with numerous wastewater problems, extensive growth and natural feature or socioeconomic limitations.

Required staff expertise and cost would be great, and the extent of regulatory authority required and the effect of public attitudes would significantly limit the number of mountain communities where such an approach would be appropriate. Even in larger communities it may be possible that private ownership of conventional collection and treatment systems is cost-effective. Though complete public responsibility does have significant benefits, the implementation problems may outweigh them in all but the most populous communities in which other "urban-type" services are provided.

2.3 Summary of Financial Alternatives

There are several sources of funds available to small communities in the study area for solving wastewater problems. These sources include federal, state and local governments as well as private entities.

Probably the major source of funds for wastewater projects at the Federal level is the U.S. Environmental Protection Agency's (EPA) Construction Grants Program. Generally, construction grant funds have not been available to rural communities because of competition with urban and suburban areas for these funds. Inclusion on a state priority list for funding of a wastewater project is a prerequisite for construction grant funding. Where a potential project falls on the list is largely dependent on the degree of impact to water (surface or ground) quality. Hence, priority areas tend to be developed communities which discharge to surface water where most water quality monitoring has taken place. One advantage a rural area has in obtaining construction grant funds is that if a state has a rural population of 25 percent or more it must reserve four percent of its allotment for small communities to implement alternatives to conventional wastewater systems.

Other federal funding sources available to small communities include grants and loans from the Farmers Home Administration (FmHA) especially targeted for water and wastewater disposal systems in rural areas; Appalachian Regional Commission (ARC) grant funds; and U.S. Economic Development Administration (U.S. EDA) funding mechanisms. The objective of both ARC and EDA wastewater funding is economic development residential use.

Each of the six study area states with the exception of Alabama has some type of grant or loan program for funding wastewater facilities. Generally, the objective of these local funding programs is to cover part of the local

costs to communities which have received a Federal grant for wastewater facilities. In addition, state governments may receive Community Development Block Grants which are available to fund sewer projects in small communities. The grant program is managed directly by each state.

Local funding sources, such as general obligation bonds, revenue bonds, bond anticipation notes and commercial bank short-term loans, may be used to either match Federal grants or to totally finance wastewater facilities if Federal or State funds are not available.

In addition, a community must implement a system for generating funds for annual operation and maintenance. These sources of revenue can include special assessments, connection charges, tapping fees and sewer rentals. Taxes are generally used only as a last resort to support system operation. In many instances, although these mechanisms are available to small communities, they are not normally taken advantage of because of the limited financial capability of a small, rural community.

Private funding sources available to small communities include short-term bank loans, private investment by developers and private company ownership and operation of facilities. None of these sources has been frequently applied to small communities. Short-term bank loans can have relatively high interest rates, effectively pricing out many small, rural communities. A private developer may construct a facility, but generally operation and maintenance is turned over to the community which, as discussed previously, generally does not have the resources to finance an effective, long-term O&M program. Most private ownership and operation of wastewater facilities has occurred in urban areas and, since this trend is fairly new, it is too early to determine if it will spread to the study area.

In order to select the financing methodology best suited to its particular circumstances, a small community must review all of the above available options, focusing on grant/loan eligibility and availability, local financing and revenue requirements and financial capability to support local requirements.

2.4 Findings and Conclusions

The intention of this report is to present a range of alternative technical, management and financial systems which may be more suitable to the particular wastewater needs of mountain communities than prevailing approaches. Each chapter presents information on methods for evaluating the alternative systems and selecting those which may be most appropriate for the needs of a specific community. There is no detailed evaluation of each alternative and no recommendation of specific approach for specific communities. Such information will be more thoroughly developed in later phases of the mountain communities assessment.

Because of the overall objective of the material in this report, it is not in general of a conclusionary nature. However, there are certain findings with regard to alternatives in each of the three chapters that would be useful to identify. Regarding technical alternatives, the following findings are significant:

- even the complex physical limitations in the study area can be overcome by certain technical approaches,
- for many communities renovation of existing on-site systems and water conservation measures may be most effective alternatives,
- methods for ensuring proper design and installation and enhancing operation of conventional or less complex systems may be preferable to use of costly, complex techniques,
- on-site systems can meet wastewater and water quality needs in most communities on a cost-effective basis, provided the systems are properly designed, operated and maintained,
- for many communities, centralized systems may be too complex and costly.

For institutional management alternatives, the following significant findings have been identified:

- the function of problem identification and planning is too often not carried out,
- management systems vary in their range of public sector control from almost no public agency involvement to total ownership and control,
- regardless of whether public or private entities are responsible, for management to be effective, the following seven functions must be carried out:
    - problem identification,
    - system planning and design,
    - construction and installation,
    - permitting,
    - operation and maintenance,
    - monitoring and compliance,
    - training and public education.
- conventional homeowner-centered management is adequate only for on-site systems and in the past has not provided sufficient incentives to properly operate or maintain systems,
- full public ownership and management may not always be appropriate, even for communities with centralized systems because of higher costs, public reaction and the level of expertise necessary,
- the most appropriate techniques will be those which blend private and public responsibilities and provide sufficient controls or incentives to ensure proper system operation and maintenance.

For financial alternatives, the following findings have been identified:

- U.S. EPA Construction Grant funding is the primary source of Federal funding for wastewater projects, however, few rural communities have received such funding due to stiff urban/ suburban competition,
- generally, most state funding programs only provide funds to cover that part of a project not covered by Federal funds,
- although a small community may be able to partially fund the implementation of a system, the financial capability of the community's population may not allow for effective, long-term operation and maintenance of a system,
- small communities may not generally rely on private funding sources for their wastewater projects because of a lack of revenue to support adequate O&M of a system built by a private developer and also because many private investors have not, as yet, been attracted to small, mountainous communities.
- money for planning is difficult to obtain from any of the funding sources.

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